

ART. XI.—*Trilobites of the Family Calymenidae from the Palaeozoic Rocks of Victoria.*

By EDMUND D. GILL, B.A., B.D.

[Read 9th December, 1943; issued separately 30th June, 1945.]

Summary.

Four new species of trilobites—*Calymene bowiei*, *C. killarensis*, *Gravicalymene hetera*, and *G. kilmorensis*—are described, *Gravicalymene angustior* (Chapman) re-described, and notes provided on other forms. Descriptions and maps of new fossil localities are given. The bearing of these determinations on stratigraphy is discussed.

Introduction.

Trilobites of the genera treated in this paper are known in Victoria only from Upper Silurian and Lower Devonian rocks. They comprise the following species:—

<i>Species.</i>	<i>Age</i>	<i>Stratigraphical Series.</i>
<i>Calymene bowiei</i> sp. nov.	Lower Devonian	Yeringian
<i>C. killarensis</i> sp. nov.	Lower Devonian	Yeringian
<i>Gravicalymene angustior</i> (Chapman)	Lower Devonian	Yeringian
<i>G. hetera</i> sp. nov.	Upper Silurian	Melbournian
<i>G. kilmorensis</i> sp. nov.	?Upper Silurian	?Melbournian
<i>G. cf. kilmorensis</i> sp. nov.	Upper Silurian	Melbournian
<i>Flexicalymene</i> sp.	?Upper Silurian	?Melbournian

The determinations of fossils in this paper supersede lists previously given (Gill 1938, 1939).

Systematic Descriptions.

Family CALYMENIDAE II. Milne Edwards, 1840.

Genus CALYMENE Brongniart, 1822.

Genotype **Calymene blumenbachi** Brongniart, 1822.

Chapman referred a trilobite from Moonee Ponds Creek, Melbourne, to the above genotype (Chapman 1914, p. 219; 1915, p. 166). The specimen, which consists of thorax and pygidium only, is in the National Museum (reg. No. 452), but as the cephalon is not present, a determination is not attempted. In the 1914 paper (p. 228) *C. blumenbachi* is also recorded from "Upper Yarra". This is apparently the same specimen as was later described as *C. cf. blumenbachi* (Chapman 1915, p. 166, pl. XV., fig. 11). This specimen is in the National Museum, comes from Section 12, Parish of Yering (which in this case is "Flowerfield" Quarry—Gill, 1939), and is No. 1862 of the Geological Survey of Victoria collection. Unfortunately, the preservation is poor, and determination is not attempted. Chapman also recorded "*C. cf. tuberculata* Salter" from Kilsyth, near Croydon

(Chapman, 1907, p. 239; 1914, p. 228), which species has since been re-named *C. nodulosa* (Shirley, 1933, p. 53). This specimen (also housed in the National Museum) consists of a few segments of the thorax only, and a determination is not attempted. Selwyn (1855-6) and Smyth (1874, p. 34) record *C. tuberculata* from "Upper Yarra". This is probably the specimen in the National Museum (reg. No. 451) which is complete but ill preserved, and labelled as being from "Yering, Upper Yarra". The matrix suggests that it originates from "North of Lilydale". The specimen does not admit of precise determination by modern standards. "*Calymene* sp." has been recorded from numerous localities, but in most instances the specimens on which the determinations were based cannot now be traced.

***Calymene bowiei*, sp. nov.**

(Plate VII., figs. 1, 2, 6.)

Type Material.—The internal cast of a cranidium and external mould of same (syntypes) in the National Museum, Melbourne (reg. Nos. 14504 and 14505), collected from fawn mudstone at Syme's Homestead, Killara (locality 33).

Age.—Yeringian Series—Lower Devonian.

Description.—Cephalon strongly convex; of the profile shown in fig. 1A. Glabella very convex, being raised well above the level of the fixed cheeks. Glabella much wider posteriorly than anteriorly, i.e., markedly bell-shaped in outline; does not overhang pre-glabellar field; projects well forward of the fixed cheeks. Posterior glabella lobes large, squarish in outline, and joined to the middle part of the glabella by narrow bridges which are lower in level than the lobe. The bifurcated furrows in front of the posterior lobes leave small protuberances or interlobes between the posterior lobes and the middle ones. The second or middle lobes are markedly smaller than the posterior ones. They are stumpy, but not flattened on the ends as in *C. killarensis*. Opposite the second lobes the fixed cheeks draw in towards the glabellar lobes to form buttresses, but these are not flattened on the tips as they are in *C. killarensis*. The anterior lobes are small, and consist only of dorso-ventral ridges on the sides of the main body of the glabella. There are no fourth lobes. Main body of glabella much higher than lobes. Eyes opposite middle lobes. "Antennary" pits occur in the floor of the axial furrows opposite where the fourth lobes usually appear. The axial furrows are deep, wide in front, and narrow behind the buttresses. Sutures much the same as in *C. killarensis*. The inner margins of the fixed cheeks run directly posteriorly till they draw in towards the glabella to form the buttresses opposite the middle lobes. From the buttresses to the intramarginal furrows the margins curve outwards to give the general bell-shaped appearance of the glabella region. The pre-glabellar field is short, shallow, and

recurved. The recurved margin is thin, and is directed forwards and slightly upwards (fig. 1A). Posterior intramarginal furrows broad; posterior walls a little steeper than the anterior walls. Occipital ring narrows at its extremities, which turn in towards the corners of the fixed checks. Genal angles rounded.

Length of holotype cranium.—21 mm.

Width from genal angle to centre of glabella.—25 mm.

Comment.—The cephalon is tuberculated, but the precise nature of the ornament is not clear because of a layer of iron oxide over the external mould (paratype). *C. bowiei* is readily distinguished from the genotype (*C. blumenbachi*). The former has a bell-shaped glabella as against the squarish outline of the latter. In the genotype, the axes of the glabella lobes run transversely whereas in the new species they are directed forwards at an angle of about 20° to the transverse. The pre-glabella field of *C. bowiei* (fig. 1A) is of the type of *C. aspera* (vide Shirley, 1936, pl. XXX., fig. 10) rather than that of *C. blumenbachi* (vide Shirley, 1933, pl. 1, fig. 3).

A few specimens have been noted in which the pre-glabella field is more upturned than in the holotype. A sufficient range of specimens has not been procured yet, however, to enable one to determine whether this is a varietal difference, or one due to slight compression. The free cheeks are missing from the holotype, but

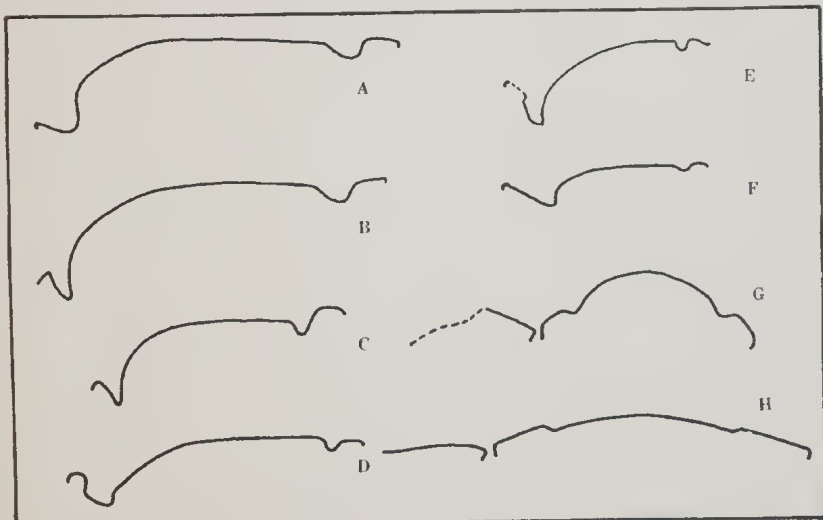


FIG. 1.—Longitudinal median profiles of the cephalons of *A* *Calymene bowiei* sp. nov., *B* *C. killarensis* sp. nov., *C* *Gravicalymene angustior* (Chapman), *D* *G. hetera* sp. nov., *E* *G. kilmorensis* sp. nov., *F* *Flexicalymene* sp.; transverse profiles through the second glabellar lobes of the cephalons of *G* *Calymene bowiei* sp. nov., *H* *C. killarensis* sp. nov., showing contrast in tumidity.

the general outline suggested by the cranidium is that of one tending towards a triangular shape. *C. bowiei* is named after Mr. Bowie, manager of the Killara estate, who directed the writer to the fossil locality from which the holotype was obtained. Specimens of *Beyrichia* and *Stropheodonta bipartita* (Chapman) occur on the same piece of rock as the type.

Calymene killarensis, sp. nov.

(Plate VII., figs. 8, 3, 4.)

Type material.—The internal cast of a cranidium (holotype) in the National Museum, Melbourne (reg. No. 14506), collected from the bluish-grey shale of Syme's Tunnel, Killara (locality 34).

Age.—Yeringian Series—Lower Devonian.

Description.—Cephalon moderately convex; of the profile shown in fig. 1B. Glabella broad (compare the genotype), overhanging the axial furrows; projects well forward past the fixed cheeks. Four lobes on each side, reducing sharply in size posterior-anteriorly. First lobes almost quadrangular, and connected with the main body of the glabella by bridges which are almost as elevated as the lobes themselves. The main body of the glabella, the bridges, and the lobes form a more or less continuous arch, and contrast in this respect with *C. bowiei* (figs. 1c, n). Second lobes elongated, and flattened on the ends, which are in juxtaposition with buttresses on the fixed cheeks; these second lobes are very noticeably directed forwards, making an angle of about 30° with a line joining the posterior margins of the eyes. Third lobes small, with strong furrowing behind, but shallow furrow in front. Fourth lobes consist of small bulges on sides of glabella, but there are definite furrows in front of and behind these lobes. There are small, rather sharp intermediate lobes between the first and second lobes. Large "antennary" pits lie in the axial furrows beside the fourth lobes. The preglabellar field is short, shallow, and recurved. The recurved part is thin, and projects outwards and upwards at an angle of over 45° with the horizontal (fig. 1B). Eyes opposite second lobes. Axial furrows moderately wide in front of the buttresses, and narrow behind them. Sutures begin just above genal angles and curve in towards the eyes, become almost parallel with the posterior margin of the cephalon when nearly to the eyes; from the eyes the sutures run straight forward to the anterior margin of the cephalon. Posterior intramarginal furrows broad; posterior walls a little steeper than the anterior walls. Occipital ring narrows at the extremities, which turn in towards the corners of the fixed cheeks. Genal angles rounded. Small pieces of the external mould obtained when clearing the fossil of matrix showed the cephalon to have been ornamented with a fine granulation.

Measurements of holotype.—Length of cranidium, 20 mm.; width of genal angle to centre of glabella, 25 mm.

Comment.—The examination of a number of specimens suggests that the axial furrows narrow slightly with age. The thorax is not known. Occasional pleurae are found but no complete thorax has yet been discovered, although the species is quite common at Killara, after which place the fossil is named. Pygidia are common, and probably belong to the same species. They are broad and very convex, with deep axial furrows. There are seven axial rings, and five pleural ribs, the last of which is parallel to the axis. The first four are bent backwards and are grooved distally for about half their length. The pygidium is closely and finely granulate. The cast and mould from which this description of the pygidium has been made, have been lodged in the National Museum (reg. Nos. 14511 and 14512).

The new species is comparable with *C. blumenbachi* which it resembles in its large sub-rectangular glabella. The chief differences are:—(1) The frontal lobe of the glabella does not overhang the pre-glabellar field as in *C. blumenbachi*. (2) The first lobes are even more quadrilateral in the new species than in the compared one. The second lobes, like those of *C. blumenbachi*, "when viewed from above show a papillate outline as if reaching out to the buttress on the fixed cheeks" (Shirley, 1933, p. 60), but much more so, and instead of being directed transversely, they are directed forwards as described. Judging from Shirley's figures (1933, pl. 1), the fourth lobe on our species is much better developed.

Occurrence.—*Calymene killarensis* has been collected by the author from Syme's Tunnel, Killara (loc. 34), and Syme's Homestead, Killara (loc. 33). A crushed specimen from the road cutting near the limestone quarry at Seville (loc. 38) probably belongs to this species. Chapman (1908, p. 269) records *Calymene* sp. from the Seville limestone (loc. 37). A plasticine impression of this mould shows that the specimen has buttresses opposite the second, and therefore belongs to the genus *Calymene sensu lato*. However, the preglabellar field is not preserved. These localities are shown on fig. 2, the numbers following on those previously used (Gill, 1940).

Genus GRAVICALYMENE Shirley, 1936.

Genotype **Gravicalymene convolva** Shirley, 1936.

When Shirley established the sub-genus *Gravicalymene*, the genotype was the only species known, and this came from the Upper Bala of Britain. Since then four other species have been referred to this genus, and another is now added in this paper.

When describing the Baton River (N.Z.) Beds, Shirley (1938) referred *Calymene angustior* Chapman to this genus, and also *C. australis* Etheridge and Mitchell, which he thought was almost certainly synonymous with the former. The present writer referred a new species, *Gravicalymene cootamundrensis* to this genus (1940), and later referred *Calymene malounkaensis* Mansuy to it, and suggested the elevation of Shirley's sub-genus to generic rank (Gill, 1942, p. 45).

Diagnosis of Genus *Gravicalymene*.—Calymenidae without papillate glabellar lobes, or buttresses on the fixed cheeks. Glabellar outline bell-shaped. Pre-glabellar field recurved with roll-like edge. Eyes opposite, or slightly anterior to, second lobes. Cephalic margin entire. Thorax (where known) of thirteen segments.

Range of Genus.—Ordovician to Devonian.

Occurrence in Victoria: Three species of this genus are known from Victoria, viz., *G. angustior* (Chapman), *G. hetera* sp. nov., and *G. kilmorensis*, sp. nov.

Gravicalymene angustior (Chapman).

(Plate VII., figs. 5, 10.)

Calymene angustior Chapman, 1915, pp. 164-166, Pl. XV., figs. 8-10.

Calymene australis Etheridge and Mitchell 1917, pp. 481-486, Pl. XXIV., figs. 1-3, ?4, 6-7.

Calymene (*Gravicalymene*) ?*angustior* Shirley, 1938, p. 487, Pl. XLIV., fig. 17.

Gravicalymene angustior Gill, 1942, p. 45.

The following is a re-description of this species from the holotype, and (where indicated) from the paratype presented by Chapman.

Carapace.—Measurements approximately 54 mm. long and 39 mm. wide. The carapace is damaged and so precise measurements are not possible. Widest across genal angles, and tapering to the posterior end of the pygidium.

Cephalon.—Sub-semi-circular and about a third length of carapace.

Narrow, bell-shaped glabella projecting a little beyond the fixed cheeks, with three distinct and a fourth incipient lobes on each side, reducing sharply in size posterior-anteriorly. Glabella tumid, elevated above fixed cheeks, and of the profile as drawn in fig. 1c. Pre-glabellar field (seen only in paratype) with roll-like thickened edge, which is somewhat more thickened opposite the axial furrows. Eyes slightly anterior to the middle of the second lobes.

As the anterior margin of the holotype has been destroyed, the following measurements to give the proportions of the cephalon are taken from the paratype. However, the genal angles of the paratype are obscured by matrix, and right free cheek is displaced. There has been a slight oblique crushing of the cephalon.

Length of paratype cephalon, 14.5 mm.

Width of paratype cephalon, 30 mm.

Length of glabella, 10 mm.

Width of glabella across third lobes, 7 mm.

Width of glabella across first (posterior) lobes, 10 mm.

A hypotype (Pl. VII., fig. 5), consisting of a cephalon (National Museum, reg. No. 14507), is now added, providing the following features:—Eyes situated about a quarter of the distance from the axial furrows to the margin of the free cheeks. Genal angles widely rounded. Free cheek suture commences in middle of the genal “angle”, and proceeds to a point level with the posterior margin of the eye and half way between the margin of the free cheek and the eye, then proceeds to the posterior margin of the eye. From the anterior margin of the eye the suture proceeds to the anterior border of the cephalon with a slight outward curve. Cephalon finely granulated with granules of different sizes (this is also seen in the paratype). The hypotype is from Ruddock’s Quarry (location 20).

Thorax (described from holotype).—Consists of thirteen segments. Axis approximately semi-circular in cross-section, and elevated well above the pleural areas. The axial rings have a prominent knob on each side of the axis. The axis with these knobs occupies a third of the width of the thorax. Pleurae fairly flat until at about three-quarters of their length from the axis, where they are bent sharply downwards. Each pleuron is deeply grooved. The free ends of the pleurae are rounded and curled forwards a little.

Pygidium (described from holotype).—As in the thorax the axial area is elevated well above the pleural areas. The axis tapers back evenly and carries six axial rings. The pleural ribs are streamlined backwards and are grooved distally for a little more than half their length. Well-marked furrows occur where the pleural areas join the axis.

Comment.—*Gravicalymene angustior* is very much like, and therefore presumably closely related to *G. cootamundrensis*, with which it differs in the following points:—

1. The cephalon is semi-circular with widely rounded genal angles in Chapman's species, whereas the compared species has a sub-quadrilateral cephalon with much less rounded genal angles. The cephalon is very convex in the former, and flat in the latter.

2. The free cheeks are wide, and the eyes near the glabella in Chapman's species, whereas in the compared species the free cheeks are narrow, and the eyes nearer the outer margin of the cephalon.

3. The carapace is much smaller and narrower in *G. cootamundrensis* than in *G. angustior*.

Chapman's species has obvious affinities with *G. interjecta* (Corda) of Étages F and G in Bohemia (Barrande, 1852, p. 570). *G. angustior* has a different pre-glabellar field and general profile; the trifurcate furrow between the first and second lobes described in *G. interjecta* is not present. It is interesting to note this link with the Bohemian facies in Europe. *G. angustior* also appears to be comparable with *G. malounkaensis* (Mansuy) from Indo-China (Mansuy, 1916, Pl. IV., figs. 4a-c). Shirley (1938) included *Calymene australis* (Etheridge and Mitchell) in the synonymy of *G. angustior* and commented (p. 487), "From an examination of the figures and description of *C. australis* (Etheridge and Mitchell), the New Zealand material appears to be identical: the authors specially mention the thickened margin of the pre-glabellar field and the lack of buttresses on the fixed cheeks. They also express a doubt whether their species is really separable from *C. angustior* of Chapman." The new data for *G. angustior* given in this paper (the nature of the genal angles and facial sutures) may be paralleled by Etheridge and Mitchell's fig. 2, Plate XXIV. In the synonymy given above, figure 4 on Etheridge and Mitchell's Plate XXIV. is questioned because it appears to have a sub-quadrilateral cephalon reminiscent of *G. cootamundrensis*. It is hoped to clarify the relationships of these species after the war when the types become available again.

Chapman (1915, p. 166) records this species from reddish sandstone in the "Range on E. side of commonage, Kilmore". This specimen is in the National Museum (the number 1208 is printed on it in red paint), and is described hereunder as *Flexicalymene* sp.

Etheridge (1899) records "*Calymene*" from Cooper's Creek, Gippsland. This fossil (Geol. Survey No. 178) has suffered compression, but no doubt belongs to *G. angustior*. No. 174 was determined by Etheridge as "*Calymene* sp.", but was retained for further study according to the note in the G.S.V. register. It is

therefore presumably still in the Australian Museum, Sydney. The G.S.V. register states that No. 178 now figured (Plate VII., fig. 10), is the same as No. 174.

Occurrence.—*Gravicalymene angustior* is known in Victoria from the following localities:—Cooper's Creek, Walhalla; Ruddock's Quarry (loc. 20); Ruddock's Corner (loc. 21); and North of Ruddock's (loc. 39). Figure 2 shows the exact situation of the three last-named localities. The species has also been recorded from the Australian Capital Territory (Woolnough, 1939), but the specimen has not been examined by the writer.

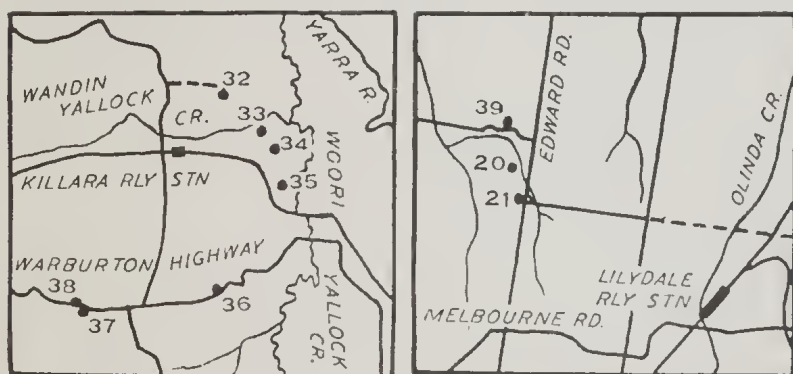


FIG 2.—Fossil localities of the Killara District and north-west of Lilydale.

***Gravicalymene hetera*, sp. nov.**

(Plate VII., fig. 12.)

In the National Museum, Melbourne, (reg. No. 14508), there is a cranidium in bluish-grey, indurated, fine-grained sandstone from Kilmore East, presented by L. C. Parker, Esq., on 12th July, 1924. This fossil has been selected as the holotype for *G. hetera*, to which also should be referred the fossil figured by Chapman (1915, Pl. XV., fig. 10) from locality "Bb20, Kilmore Creek, north of the special survey." The holotype has been distorted a little by lateral pressure.

Description.—The fossil is near *G. angustior*, but differs in the following respects:—

(1) The pre-glabella field is conspicuously wider and deeper than in *G. angustior*; the rolled "lip" is thinner and sharper than in the compared species.

(2) The glabella does not extend forward as far as it does in *G. angustior*, nor is it elevated high above the fixed cheeks as in that species. The profile is given in fig. 1d. The new species has

fourth incipient lobes as in *G. angustior*, but the "antennary pits" appear to be placed further forward. The measurements of the holotype are:

Length of cephalon, 14 mm.

Width from genal angle to centre of glabella, 20 mm.

Comment.—The Australian species of *Gravicalymene* form a compact group suggesting local evolution of the species. The occurrence of *G. angustior* in the Lower Devonian of New Zealand (Shirley, 1938) suggests some shallow sea connexion with that area as these trilobites show by their structure, the lithology in which they occur, and the fauna with which they were associated, to be of littoral habitat. The occurrence of *Gravicalymene* in Indo-China is interesting as suggesting connexion with that area.

***Gravicalymene kilmorensis*, sp. nov.**

(Plate VII., fig. 9.)

Type Material.—The internal cast of a cranidium (holotype) in the National Museum, Melbourne, reg. No. 14509, from Kilmore East, presented by G. L. Pentreath, esq., 12th July, 1924. The matrix is a bluish-grey, fine-grained, indurated sandstone.

Description.—Cephalon shorter in proportion of width to length than *G. angustior*. Glabella bell-shaped and squat, with three distinct lobes and incipient fourth lobe on each side reducing sharply in size posterior-anteriorly; does not overhang pre-glabbellar field; front of glabbellar approximately level with forward extensions of fixed cheeks. Axial furrows very open and wider anteriorly than posteriorly. Pre-glabbellar field recurved with small subsidiary ridge on roll-like edge. Profile as in fig. 1E. Edge of pre-glabbellar field not thickened opposite axial furrows as in *G. angustior*. Eyes opposite second lobes, and much nearer axial furrows than margin of cephalon. Free cheek sutures pass more directly to the posterior margin of the eye than they do in *G. angustior*. Thorax and pygidium unknown.

Comment.—*G. kilmorensis* differs notably from *G. angustior* in (1) the squat proportions of the glabbellar; (2) the wide axial furrows; (3) the presence of a subsidiary ridge on the pre-glabbellar field, and its lack of thickening opposite the axial furrows; (4) the straighter course of the post-ocular part of the free cheek sutures.

The fossil is decorticated, leaving no indication of the nature of the surface ornament (if any). It is named after the town in the vicinity of which it was collected.

The generic position of this fossil presents an interesting problem. *Gravicalymene* has no subsidiary ridging on the pre-glabella field according to the original diagnosis of the genus. The pre-glabella field of the holotype of *G. kilmorensis* was slightly damaged immediately in front of the glabella when the specimen was being cleared of its matrix. However, the nature of the profile, as shown in fig. 1E, is still clear to one side of this point. Shirley's *Gravicalymene* and *Flexicalymene* closely approximate to one another. The description "Thorax 13 segments; glabella outline bell-shaped; pre-glabella field recurved; axial furrows slightly contracted at each glabella furrow" would apply equally to the above two genera according to Shirley's diagnoses. The only distinguishing feature in such an instance would be "recurved without subsidiary ridging" as against "recurved with roll-like edge". The fossil now described as *G. kilmorensis* has a recurved pre-glabella field, but with a flattened slope as shown in the profile. *Diacalymene* (*vide D. drummockensis* in Shirley, 1936, p. 391) is characterized by the development of a subsidiary ridge in the pre-glabella field, but the new species cannot be referred to *Diacalymene* as that genus possesses papillate second lobes. Shirley states (1936, p. 392) that such features as the character of the pre-glabella field "must be used with caution and only in combination with other characters of the skeleton". Because of its strong affinities with species of *Gravicalymene*, our new species is doubtless best accommodated in that genus.

Gravicalymene spp.

(1) *Gravicalymene* cf. *kilmorensis*, sp. nov. A specimen in the National Museum (reg. No. 14510) from the Moonee Ponds Creek (Melbournian), collected by Mr. Spry, 5/10/22, belongs to the genus *Gravicalymene* (Pl. VII., fig 7). It is not sufficiently well preserved to make determination certain, but it is probably *G. kilmorensis*, sp. nov.

(2) From Locality 9, allotment 10, Parish of Redcastle, Dr. D. E. Thomas collected specimens of *Gravicalymene* (Geol. Surv. reg. Nos. 38006, 38007, 37974, 37989) which belong, apparently, to yet another species. The great thickness of the rolled edge on the pre-glabella field is a notable character. The material is not considered good enough on which to erect a new species.

(3) Two specimens of a species of *Gravicalymene*, very much like *G. angustior*, have been collected by the writer from Syme's Tunnel, Killara (loc. 34). However, the glabella stretches further forward than in the species named, the edge of the pre-glabella field is thinner and sharper, and in size they are very

much smaller. *Calymene (sensu lato)* is common at this locality, but the above are the only two specimens of *Gravicalymene* yet found in the district.

Flexicalymene sp.

(Plate VII., fig. 11.)

Chapman (1915) referred a trilobite from reddish sandstone from "range on east side of Reserve of Commonage, Kilmore" to *G. angustior*. This fossil was collected by the Geological Survey in 1903, and is now housed in the National Museum (reg. No. 1208). The specimen is an exfoliated cranium with a short glabella much narrower in front than behind. The glabella is produced forward of the fixed cheeks. The very wide and high pre-glabella field is the most conspicuous character of this fossil. The cephalon is 11 mm. long, and the pre-glabella field occupies 3 mm. (more than a quarter) of the length. The pre-glabella field is directed forwards and upwards at an angle of 25°-30° to the horizontal. The profile is as shown in figure 1F. The anterior edge of the pre-glabella field is rounded, but without the "draught-stopper" edge so characteristic of *Gravicalymene*. Like *Gravicalymene* and *Flexicalymene* this fossil has no buttresses opposite the glabella lobes, and the fixed cheek margins draw in slightly opposite the inter-lobe furrows.

The main features of this form are distinct, and indicate it to be a new species, but the present specimen is scarcely good enough to be made into a holotype. This is the first record of this genus from Australia. Shirley described *Flexicalymene* as a sub-genus, and elsewhere it has been raised to generic status. This lead is followed here, but it is noted that *Flexicalymene* and *Gravicalymene* closely approximate to one another, and that the differences between these genera are not as great as the differences between others of the sub-genera proposed by Shirley.

Stratigraphical Considerations.

The genera *Gravicalymene* and *Flexicalymene*, which are closely related, were described originally by Shirley from the Ordovician of Great Britain (Llandeilo and Bala Beds). Both genera are now known from the Silurian. The former genus is also known from the Lower Devonian, and the latter from beds which are either high in the Silurian or low in the Devonian sequence. The range in time of these genera has therefore been considerably extended.

Another point of interest is the geographical distribution of some of these species. *Grazicalymene angustior* has been recorded from both Australia and New Zealand. A related species has been recorded from Cootamundra, New South Wales (Gill, 1940a), and a similar species occurs in the Lower Devonian of Indo-China (Mansuy, 1916). The fauna described by Mansuy has other similarities with our Victorian one. *Styliolina* occurs there as it does in Victoria (Gill, 1941), and a shell figured on his Pl. V., fig. 10), is very like our *Chonetes robusta* Chapman. Mansuy, in 1919, described further fossils from that part of the world. His *Chonetes ningpoensis* is reminiscent of our *Chonetes cresswelli* Chapman. The spiriferid of Mansuy's Pl. 5, fig. 6, is very like an undescribed species from Lilydale.

From wide areas of the world and from different stratigraphical horizons, writers have claimed to have found *Calymene blumenbachi* Brongniart. Shirley (1933, p. 62) considers that most of these determinations should be looked upon with suspicion. It appears that in this group a high mutation rate obtained, and numerous closely related forms resulted. Shirley (1936) has described some of the forms closely related to *C. blumenbachi*, and in the present paper it has been shown that *Calymene killarensis*, sp. nov., belongs to this gens. The separation of this series of related forms into distinct species will greatly assist stratigraphical as well as palaeontological studies. A similar review is needed with such brachiopods as *Atrypa reticularis* and *Leptaena rhomboidalis*.

FOSSIL LOCALITIES.

The location of the fossil localities is shown in fig. 2. The numbers are continued from those given previously (Gill, 1940b and 1942).

32. "Killara Quarry" is a disused quarry in quartzitic sandstones (with a few interbedded shales) at the end of a disused road. *Anoplia australis* has been collected from there, and as this brachiopod is known only from beds of Yeringian age, the Killara Quarry beds are regarded as Yeringian.
33. "Syme's Homestead".—The first reference to this locality is in Gill, 1939. The fossils were obtained from an old water race near the Wandin Yallock Creek in front of the homestead of the Killara estate. The matrix is a fawn mudstone which has yielded a very rich Yeringian fauna.

34. "Syme's Tunnel".—This locality is a tunnel which was mined for the purpose of storing apples in the days before cold storage. The rocks are bluish-grey shales which are weathered often to a brownish colour near the surface. As far as can be ascertained, this locality is that which the early Geological Survey records refer to as "Junction of Woori Yallock and Yarra".
35. "Syme's Quarry" is just below the manager's house on the Killara estate, and was opened up in 1936 to provide stone for private roads on the estate. It consists of the same kind of rock as seen at locality 34 and is on approximately the same strike.
36. "Warburton Highway, Killara" was mentioned in Gill, 1941, p. 152. The locality is a road cutting where whitish mudstones, sometimes coloured red with iron oxide, outcrop. *Styliolina* is abundant.
37. "Seville Limestone" is a disused quarry on the south side of the Warburton highway on the east side of Seville. Except where the rock is weathered the fossils are very difficult to extract, as the "limestone" contains about 60 per cent. silica. Chapman (1908) has recorded fossils from this locality.
38. "Seville cutting" is a long cutting on the Warburton highway immediately west of locality 37. Shales and sandstones outcrop with occasional fossiliferous bands. West of this point to where the bedrock disappears under the igneous rocks of Mt. Dandenong, the outcrops appear to be unfossiliferous.
39. "North of Ruddock's" is a low road cutting north of locality 20. The matrix and fauna are the same as at localities 20 and 21.
- Bb20 is a Geological Survey locality so marked on Quarter Sheet 4 SW, where a note refers to the presence of "*Calymene*". Harris and Thomas (1937, p. 77) refer to the presence at Bb20 of *Monograpti* comparable with forms found in the Melbournian beds.

Acknowledgments.

For access to materials and many other courtesies I am indebted to Professor H. S. Summers of the Geology Department, University of Melbourne, Mr. D. J. Mahony, M.Sc., and Mr. R. A. Keble, F.G.S., Director and Palaeontologist respectively of the National Museum, and Mr. W. Baragwanath of the Geological Survey of Victoria. The photographs are the work of Mr. L. A. Baillôt, of the Melbourne Technical College.

References.

- BARRANDE, J., 1852.—Systeme Silurien du Centre de la Bohême, Pt. 1, Prague.
- CHAPMAN, F., 1907.—On the Occurrence of Yeringian Fossiliferous Mudstone at Croydon. *Vic. Nat.*, xxiii. (11), pp. 237-239.
- , 1908.—Reports on Fossils. *Rec. Geol. Surv. Vic.*, 2 (4), p. 210.
- , 1914.—On the Palaeontology of the Silurian of Victoria. *Aust. Assoc. Adv. Sci.*, xiv., pp. 207-235.
- , 1915.—New or Little-known Fossils in the National Museum, Melbourne. Pt. XVIII. Some Yeringian Trilobites. *Proc. Roy. Soc. Vic.*, n.s., 28 (1), pp. 164-166.
- ETHERIDGE, R., 1899.—Description of New or Little-known Victorian Palaeozoic and Mesozoic Fossils, No. 11. *Prog. Rept. Geol. Surv. Vic.*, pp. 22-24.
- ETHERIDGE, R., and MITCHELL, J., 1917.—The Silurian Trilobites of New South Wales, with References to Those of Other Parts of Australia. *Proc. Linn. Soc. N.S.W.*, xliii., pp. 480-510.
- GILL, E. D., 1938.—Yeringian Trilobites. *Vic. Nat.*, liv., pp. 167-171.
- , 1939.—The Silurian Trilobite *Lichas Australis*. *Mem. Nat. Mus.*, 11, pp. 140-142.
- , 1940a.—A New Trilobite from Cootamundra, N.S.W. *Proc. Roy. Soc. Vic.*, n.s., 52 (1), pp. 106-110.
- , 1940b.—The Silurian Rocks of Melbourne and Lilydale: A Discussion of the Melbourne-Yeringian Boundary and Associated Problems. *Proc. Roy. Soc. Vic.*, n.s., 52 (2), pp. 249-261.
- , 1941.—The Place of the Genus *Styliolina* in the Palaeozoic Palaeontology and Stratigraphy of Victoria. *Proc. Roy. Soc. Vic.*, n.s., 53 (1), pp. 145-164.
- , 1942.—The Thickness and Age of the Type Yeringian Strata, Lilydale, Victoria. *Proc. Roy. Soc. Vic.*, n.s., 54 (1), pp. 21-52.
- HARRIS, W. J., and THOMAS, D. E., 1937.—Victorian Graptolites (New Series), Part IV. *Min. & Geol. Journ.*, 1 (1), pp. 68-79.
- MANSUY, H., 1916.—Faunes Paléozoïques du Tonkin Septentrional. *Mem. Serv. Geol. Indochine*, v. (4), p. 41.
- , 1919.—Description de Quelques Espèces du Dévonien du Tonkin, du Laos, et du Carbonifère du Yunnan. *Mem. Serv. Géol. Indochine*, vi. (1).
- SELWYN, A. R. C., 1855-6.—Report of the Geological Surveyor on the Geological Structure of the Colony of Victoria. *Notes and Proc. Legis. Council*, 2 (1).
- SHIRLEY, J., 1933.—A Re-description of the Known Silurian Species of *Calymene* (s.l.). *Mem. Manchester Lit. Phil. Soc.*, 75, p. 1.
- , 1936.—Some British Trilobites of the Family Calymenidae. *Q.J.G.S.*, xcii. (3), pp. 384-422.
- , 1938.—The Fauna of the Baton River Beds (Devonian), New Zealand. *Q.J.G.S.*, xciv. (4), pp. 459-506.
- SMYTH, R. B., 1874.—*Progress Report, Geol. Surv. Vic.*, pp. 1-45.
- WOOLNOUGH, W. G., 1938.—Geology and Physiography of the Australian Capital Territory and Surrounding Areas. Handbook for Canberra. *Aust. & N.Z. Assoc. Adv. Sci.*, pp. 111-118.

Description of Plate.

PLATE VII.

- FIGS 1, 2, 6.—*Calymene bowici* sp. nov. 1 and 2 internal cast and external mould respectively, $\times 1\frac{1}{2}$ approx. Fig. 6 is part of the glabella in fig. 1 enlarged to show nature of ornament as seen on internal cast.
- FIGS. 3, 4, 8.—*Calymene killarensis* sp. nov. Figs. 3 and 4 are the internal cast and external mould respectively of a pygidium believed to belong to this species. Fig. 8 is the holotype cranium $\times 2$.
- FIGS. 5, 10.—*Gravicalymene angustior* (Chapman). Fig. 5 is the hypotype showing position of the eye and the nature of the suture between the free and fixed cheeks. Fig. 10 is a compressed cephalon referable to this species from Cooper's Cr., Gippsland.
- FIG. 12.—*Gravicalymene hetera* sp. nov. Holotype, $\times 2$.
- FIG. 9.—*Gravicalymene kilmorensis* sp. nov. Holotype, $\times 2$.
- FIG. 7.—*Gravicalymene* cf. *kilmorensis* sp. nov. Specimen from Moonee Ponds Creek $\times 2$.
- FIG. 11.—*Flexicalymene* sp. $\times 2$.

